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ABSTRACT

This brochure, one in a series of four, is designed to assist school, community, and university personnel as they develop and refine programs to encourage girls in mathematics, science, and engineering. The information is divided into seven sections. The first section discusses four reasons why programs that encourage girls to enroll in mathematics, science, and engineering are needed. The reasons cited are that: (1) women are underrepresented in science and engineering employment; (2) that mathematics is a filter for students going on to college; (3) despite increased enrollment in high school mathematics and science, middle-class girls are less apt to major in mathematics, science, and engineering in college; and (4) low-income girls have had less access to programs than middle-class girls. The second section lists eight characteristics common to effective programs. The third section discusses four ways to get girls to take more mathematics and science. The fourth section considers ways to encourage girls to consider mathematics and science careers. The fifth section presents ideas to assure participation of girls from junior and senior high school. The sixth section discusses the need to evaluate programs and presents five ideas that need to be considered when evaluating a program. The final section discusses the challenges of making effective programs permanent parts of host organizations, of encouraging teachers to implement effective practices that are part of the programs, and of making programs equitable for girls. A list of four resources is provided. (MDH)

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Nothing Can Stop Us Now

Designing Effective Programs for Girls in Math, Science, and Engineering

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U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
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Why Bother About Girls in Math, Science, and Engineering?

This brochure is designed to assist school, community, and university personnel as they develop and refine programs to encourage girls in math, science, and engineering.

Programs to encourage girls in these areas are needed for the following reasons:

1. Today white women and women of color continue to be underrepresented in science and engineering employment. This is due in part to their relatively low participation in higher-level college science and mathematics courses.
2. Math is still a critical filter. Low-income students and students of color who take algebra and geometry go to college in numbers equal to wealthier whites. However, only half as many low-income students and students of color take these critical courses.
3. Middle-class girls now take about the same number of high school math and science courses as do middle-class boys. However, in college these girls are much less apt to major in math, science, or engineering fields than are similarly talented boys. They also drop out at higher rates.
4. Low-income girls have had access to far fewer programs than have middle-class girls. For them there is a need for programs to center on

- increasing interest in math
- changing student and teacher expectations
- encouraging girls to take enough math so they can have a wider choice of either college majors or post-high-school jobs

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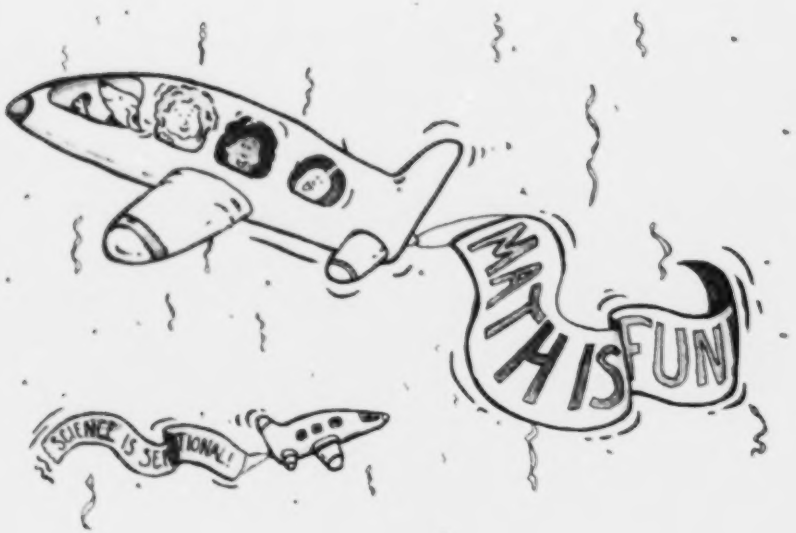
What Makes a Good Program?

Out-of-school programs that keep both white girls and girls of color interested in math and science and continuing to take math and science courses two to three years after participating in these programs, have some important things in common:

- They are considered by the girls to be *not like school!*
- They are *fun!*
- They include a *lot* of hands-on activities, projects, and opportunities.
- They are much less concerned with increasing cognitive knowledge than with helping girls *do* new things.
- They are relaxed, with little, or no, emphasis on individual competition.
- They provide opportunities for girls to speak informally with women (and sometimes men) in math and science careers and to learn about their personal and professional lives.
- They not only provide time for questions, but the staff anxious to answer those questions, so that the girls know someone is there who will keep working with them until they can say, "I've got it!"
- They include evaluation of what's working and what's not and use the results for program improvement.

Many of these suggestions can also be used by in-school programs to increase girls' math and science involvement.



How Do We Get Girls to Take More Math and Science?

Intervene in 8th grade.

In 8th grade, most students decide if they will take algebra in 9th grade, an important first step to continued math involvement (although more advanced students may take algebra in 8th grade). After being in a program with activities showing that algebra can be fun, and being encouraged that they could do math, one group of urban, Hispanic, 8th grade girls all decided to take algebra.

Intervene in 10th grade.

Sophomore year is another key decision-making time. While girls and boys are equally apt to take math until math requirements for college admission are fulfilled, girls are more likely than boys to stop here and take no more math.

Have the program reflect what girls feel they are missing in math classes.

Girls decided to take more math and science (and continue taking the courses) after participating in math sessions that they saw as

- more fun
- more relaxed, with more small-group work
- more hands-on, problem solving
- containing more teacher explanation and question answering to "make sure you understand"

Reinforce the positive messages with follow-up such as reunions or additional sessions.

Without a support system, some changes created by program interventions were found to fade as the girls returned to an unchanged environment that had not encouraged them in the first place.

How Do We Get Girls to Consider Math and Science Careers?

Get girls beyond the "nerd" factor.

Stereotypes about people who are good in math and science are still a problem. Informal social sessions with women and men scientists from different ethnic groups have been shown to change high school girls' views of people who are good in math and science from "nerdy" and "strange" to people who are social and have a sense of humor. This holds for both white girls and girls of color.

Emphasize career exposure, not career choice.

Sessions on selecting a career for high school and middle school students don't seem to work. In several different programs they were among the least positively rated activities and were rarely included in "what was best" about a program. TV role models appeared to have a greater short-term impact on career choice. However, talking with scientists and engineers about their work caused girls in several programs to consider those careers for themselves.

Have girls involved in activities that reflect what people working in different science and math careers do.

Participating in hands-on engineering activities made girls in one program *six* times more likely to consider engineering as a career.

Reduce the isolation frequently felt by girls who are already interested in math and science.

Scheduling time for girls to "just talk" to each other helped them to find out that there are "girls just like me" who "have the same problems [of being a 'smart' girl in math and science]." Two and three years after one program, more than two-thirds of the girls were continuing to keep in touch and provide each other with an ongoing support structure.

How Do We Get Girls to Come to Programs?

Junior high/middle school

Combining opportunities to do sports with math and science activities attracts girls with little interest in math and science to come to intensive math and sports programs.

Linking the program to existing organizations such as Girls Incorporated (formerly Girls Clubs of America) and after-school programs provides girls with math and science activities as part of their regular daily activities.

Scheduling one-day Saturday "kickoff" sessions for parents and girls causes some parents, who otherwise would not give their daughters permission to come, to allow their daughters to attend.

High school

Intensive summer residential programs attract many more girls than do programs based on weekly or other regular school year sessions.

Programs conducted during the school year have better attendance if they are done in conjunction with a class or if students receive extra credit for participating.

Once girls reach working age, their financial situation requires many of them to work. Programs scheduled at the end of June or toward the end of August make summer jobs and program attendance a possibility.

High school math and science teachers and guidance counselors are helpful in recruiting girls for programs.

Identifying urban guidance counselors by name, sending them information, and following up with them has maintained a 40–50 percent minority application rate for a residential program for top female math and science students.

Why Evaluate?

Just having a program is not enough; neither are good intentions. One study found that having "special programs for women" did not mean there would be more women engineering students. Nor did it mean that women would be more apt to stay in engineering. It is the quality of a program, not just its existence, that counts.

Evaluation is necessary to see what is working, what isn't, and why. For example, using evaluation, programs have found that

- when a summer program math class too closely resembled a good "regular" math class, student math- and science-course-taking plans did *not* increase
- when sessions focused on barriers to women in science rather than on solutions, girls' concerns about going into science increased rather than decreased

To evaluate a program consider

1. Using interviews and rating forms to find out what students liked, didn't like, and *why*
2. At the beginning and end of the program, asking students about such things as

   - their math- and science-course-taking plans
   - their math and science likes and dislikes
   - their career interests
   - their ideas about what people who are good in math and science are like
   - their knowledge of the usefulness of math

3. Following up with students at least a year later to see if any changes have "stuck"
4. Breaking down the information by race so you can look at the responses of girls from different ethnic groups as well as girls as a whole
5. Using all the information collected to refine and make changes in the program

What Challenges Are Left to Face?

Institutionalize effective programs.

Programs to encourage girls in math and science are "dependent on the kindness [or at least the funding] of strangers." Effective programs need to become budget items of the organizations that have hosted them for so long.

Reach large numbers of teachers.

There will never be enough programs to reach all students who need them. Yet many of the characteristics of effective programs—more hands-on, more fun, less individual competition—can, and should, become a part of all math and science classes.

Move away from the syndrome of "them that has, gets."

Most special programs are for boys and girls. Yet in co-ed programs—even those incorporating gender equity—boys tend to get the lion's share of attention and opportunities. Indeed, at the end of one such program, teachers listed fewer girls as interested in science than they did before the program started! We must learn how to make special programs special for all.

Resources

Math/Science Network, 678 13th St., Suite 100, Oakland, CA 94612 (510)893-MATH. Supports hands-on career days on women in science. Publications include *The Sky's the Limit in Math-Related Careers* and *Expanding Your Horizons in Science* and *Mathematics: A Handbook for Conference Planners*. These publications are available through the WEEA Publishing Center (800)225-3088.

Operation SMART™. Girls Incorporated, 30 East 33rd St., New York, NY 10016 (212)689-3700. Provides materials and models for working with girls in out-of-school settings. Publications include *The Power Project: Operation SMART™ Activity Guide* and *Spinnerets and Know-How: Operation SMART™ Planning Guide*.

Women in Engineering Program Advocates Network (WEPAN), c/o Women's Programs, Stevens Institute of Technology, Hoboken, NJ 07030 (201)216-5245. National network to increase the recruitment and retention of women in engineering education.

The research and evaluation results on which this brochure is based are available from Campbell-Kibler Associates, Groton Ridge Heights, Groton, MA 01450.

Other brochures in this series include

"Math, Science, and Your Daughter: What Can Parents Do?"
"What Works and What Doesn't? Ways to Evaluate Programs for Girls in Math, Science, and Engineering"
"Working Together, Making Changes: Working in and out of School to Encourage Girls in Math and Science"

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